

"GERMAN ZEPPLINS HAVE BEEN ONE OF THE GREATEST SUCCESSSES OF THE WAR," SAYS ENGLISHMAN

Made Possible the Sinking of Three British War Vessels Says an Expert.

(By H. C. GREY)

Editor of the Aeroplane, London. LONDON, May 6.—During 1915 the airship, formerly somewhat despised by the public eye, so it seems well to devote considerable attention to this class of aerial vehicle. In the first place, it is only fair to make it clear that in neglecting airships those who were directly responsible for British aerial policy during the three or four years preceding the war did quite the right thing.

The government, which really and truly represented the people of the country in this matter at any rate took practically no interest in things aeronautic. Consequently, the amount of money obtained by the air department at the admiralty and by the department of military aeronautics at the war office was very definitely limited.

True, Winston Churchill, who was personally intensely keen on aviation, managed to extract more money for the air department than any one on the financial side intended should be spent on aircraft; and this must be accounted to him for righteousness, whatever one's views of his other actions may be, for without this support many British aeroplane manufacturers would have been "broke" long before the war, and so sources of aircraft supply would have been practically non-existent. Still, even Mr. Churchill could not drag forth unlimited money from the pockets of the treasury or the million or two pounds which would have been needed to start an airship fleet would have seemed infinite wealth in those days before Britain began to "think imperially" at the rate of five million a day or thereabouts.

Score One for the Aeroplane.

Consequently, money being limited, the naval air department and the department of military aeronautics had to make up their minds whether to spend their little bit of pocket money on airships or on aeroplanes. Now, an airship of the Zeppelin class would have cost probably 250,000 pounds to build—for a first-class, anyhow—and it would have needed at least two sheds in different parts of the country, away from where it was built, so that it could find a refuge at the end of its cross country experimental trips, and these sheds would probably have cost another 20,000 pounds apiece; so that, all told, with these and other outside charges, half a million pounds would have gone before even one satisfactory big airship had been produced. Such a sum spent on an experiment would have staggered humanity in England in those days.

Aeroplanes, on the other hand, cost only about 1,000 pounds apiece, so that with 100,000 pounds spent on 100 aeroplanes and the other 400,000 pounds spent on sheds, quarters for men, pay of officers and men, motor vehicles for transport, tools, spare parts and all the other expenses of an aeroplane establishment, it was possible to make quite a respectable little show, to learn a great deal about aeroplanes, to train a number of pilots, to lay out several aerodromes and altogether to form the nucleus of a really effective if very small aeroplane force. Which is precisely what was done.

If the available money had all been spent on airships, England would have had no aeroplanes at the beginning of the war and no pilots and yet would not have had an airship fleet either, but merely two or three experiments. Consequently the army would have been blind at Mons for lack of aeroplanes, which probably would have meant that it would have been cut to pieces, thus exposing the French left wing and leaving the road to Paris open to the German advance. Quite possibly the war would have been over before the end of 1914, with dire results for the Allies. At best, England should have lost almost all its original expeditionary force, and would be in a far less favorable position than it has been throughout the war. Which shows that, whatever blame rests on the country for not spending many millions on both airships and aeroplanes, no blame attaches to the naval and military authorities for their alleged neglect of airships.

The Useful Work of Airships.

However, this does not mean that neglect of airships by the country and by the government was justifiable. The German airships have been one of the greatest successes of the war—as great as the German artillery, which took every one by surprise at the beginning of the war. It is mere self-deception to pretend that German airships have been of no military value—using the word military to include the work of fighting vessels to both navy and army. Scouting airships over the North Sea and the Baltic have been of the greatest help to the German fleet in detecting the presence of British ships and so enabling weaker German sea squadrons to escape and in co-operating with submarines. It has been published publicly in Germany and in Scandinavia that the crew of one Zeppelin were all given the Iron Cross for this co-operation with the submarine or submarines which ultimately succeeded in sinking the *Cressy*, the *Aboukir* and the *Hague* in the North Sea, thanks seemingly, to scouting by this Zeppelin.

If all the Zeppelin fleet together could count no more success than this one action they would have justified their existence, for these ships would pay for the majority of the Zeppelins built since war began seeing that a Zeppelin costs a mere 100,000 pounds or so and probably costs less now that the Germans have improved their methods of producing and have speeded up their output.

Their Military Value.

It must be remembered, however, that any action that hinders the operations of any army is of military value to the enemy's army, and the Ger-

mans may fairly claim that their airships have assisted them in this way. It is surely no secret now to the Germans that the greater part of Great Britain is in almost complete darkness during the night, so that the whereabouts of towns may be concealed from their airships; nor can it be a secret that railways cease running when a raid is signalled, so as not to act as guides, or that motors are forbidden to carry lights at night. And it is surely evident that these precautions must hinder the transport of munitions and the movements of munition workers during the hours of darkness. If one were able to count up all the working hours lost from this cause one would certainly find that the output of munitions of all sorts has been prevented to an appreciable extent from increasing as it might have done had all the lights of England been kept full on night after night.

It is true that airships bombs have not destroyed any important munition factory nor have they caused any enormous casualties among troops in camp, nor have they sunk ships, nor blown up naval ammunition stores, but they have undoubtedly done work of military value.

One may brand Zeppelin crews as baby killers and scoff at their bad marksmanship, or jeer at their mistaking a country village for a manufacturing city, but the fact remains that they have done useful work from their point of view.

The reports circulated by the German "wireless," boasting of havoc wrought in places which have never even been visited by Zeppelins, are, of course, deliberate lies, but they are lies with a distinct purpose in view. They are intended not only to encourage the German people, but to impress neutral nations with the power of Zeppelins and they have that effect. The Germans know that Great Britain cannot prove that they are lies without giving away precisely the information the Germans want as to where the bombs really fell, and the British official statements that the German stories are "inaccurate," "bombastic," etc., are no more likely to be believed by the Swedish, or Roumanian, or South American or even North American citizens than are the German statements. Perhaps British statements are even less believed, for throughout the war the Germans have deliberately and very carefully "doped" neutral nations with lies which it is almost impossible to disprove without telling just what the Germans would like to know about many things.

It is just as well to look this fact squarely in the face, for it is all of a piece with the policy of German airship raids, and it helps one to understand the real value of their airships as both a political and as a military force.

Moral Effects of Zeppelin Raids.

From the British point of view, apart from their harmful effect on the increased output of munitions, the various airship raids have really been of considerable value. At the time of writing something over three hundred people have been killed and over seven hundred injured in Great Britain, according to official statements, by airship bombs, a fact which is regrettable, and would never have occurred at all if those in high places had realized what some of us have been preaching ever since Mr. Bleriot flew over the channel in 1909, namely that Great Britain is no longer an island and that the command of the air is as necessary to the British empire's bare existence as the command of the sea. Nevertheless, if Britain had held such a command of the air and had staved off aerial attack as effectively as the navy has staved off naval attack, it is doubtful whether the people of Great Britain as a whole would ever have awakened to the vital importance to the country of an effective air fleet.

If the Germans had the political foresight to have saved up their Zeppelins till they had a fleet of a hundred or two of them ready to launch on England at once, as they would have had by the end of 1916, they would have not only done immense moral and material damage, but they would almost certainly have found the English, according to national custom, unprepared for them. As it is, they have sent their ships over first of all one or two at a time, and then half a dozen at a time, so that England has been able to take the measure of their effectiveness gradually, and has been warned in spite of itself to prepare defenses accordingly. The result has been that the Germans have lost ships time after time, and in due course they will find that it is impossible to navigate over British ground at all, at any rate with airships. Small, fast aeroplanes are another matter altogether, and are outside the scope of this article.

Educative Value.

As for the effects of airship raids on the people themselves, it is gratifying to find how little the people have been frightened. In fact, the educative value of the raids entirely outweighs any harmful moral effect they may have had.

Naturally, there has been a certain amount of panic where bombs have fallen in thickly populated districts, but such an amount of panic is natural where an unseen death is descending from the heavens unexpectedly. Thow a cricket ball into the air near a group of schoolboys and then shout "Heads!" See how many will run aimlessly in panic and how comparatively few will stand and watch where it is going to fall.

Much of the air bomb panic is of that sort, and it is surprising how few people really panic to the extent of leaving their homes and going to live in unraidable districts. If the panic were as great as the Germans would like neutrals to believe all the eastern and middle cities would be depopulated by now and the people thereof would be living in Wales or Cornwall.

Few people even go to trouble of buying gas masks or of repairing cel-

lars for refuge during a raid. An overwhelming percentage, even in the most raided cities, prefer to gamble on the risk, and as up to the present, the odds work out at about 5,000 to one against, the chance seems worth taking, simply to avoid the trouble of all these preparations, or it may be sheer laziness, or it may be the high moral courage of the British people, but certainly the German airships have not caused the agitation they deserve to have caused after all the trouble they have taken; which only shows that hard work alone does not bring success.

Airship Projectiles.

So much for the cause and effects of the various air raids. One may now say something of the projectiles that are used and their effects before passing on to a description of the airships themselves.

The bombs are of two kinds. The high explosive bombs are commonly known as H. B. or as T. N. T., owing to their being made of tri-nitro-toluol, an explosive of the nitro-glycerine species, but far more powerful than the nitro-glycerine itself. The T. N. T. bomb is intended solely to shatter and if such a bomb causes a fire, it is by accident. Used against houses they are fairly deadly, and a 200-pound T. N. T. bomb would probably demolish a good-sized hotel or a large block of flats if it hit fairly in the middle.

The other bombs used are incendiaries. These have very low explosive powers, but contain a deadly mixture which, when the bombs burst, spread over everything in the vicinity and effectively set fire to anything combustible. The stuff inside is called "thermit," and is of the nature of the stuff inside the fireworks known as "Bengal lights," but burns much more fiercely; in fact its burning temperature is about the hottest thing known apart from such as furnace heats or oxy-acetylene flames. The result is that "thermit" will set fire to damp materials, such as wet woodwork, when an ordinary petrol bomb would merely dry the outside.

The "thermit" bombs are generally cone-shaped things with a handle at the apex and the fuse at the base. The casing is of thin metal bound round with tarred rope, which increases the "burst" of the bomb, apparently, by its elasticity, like those spring-wound fireworks, known as "magnos," and also acts as an additional fire lighter. Occasionally, however, the bombs never burst at all, but merely combust internally, so that one picks up a metal cone full of a kind of clinker or slag and surrounded by burnt rope.

Most of these bombs are big enough and heavy enough to knock a hole through the roof of an ordinary "eligible villa residence," as the house agents call them, but would hardly smash a heavily built public building and they have no shattering power sideways; consequently, unless they land squarely in the middle of a roof they are harmless, for if they hit a slant they merely glance off and if they burst on a street they do no damage unless someone happens to be standing close by where they burst and is sprinkled with the burning "thermit."

Very Disappointing.

That is doubtless why the German airship people keep pretty closely to the system of dropping a big T. N. T. bomb or two and following it immediately by some incendiaries, so that if the high explosives falling in the street blow out the side of a house the incendiaries may stand a chance of setting fire to the wreckage.

As a rule it does not work out in practice, though good enough in theory, but the most successful fires caused by bombs have been when incendiaries have fallen on cheap "match box" dwelling houses, or in storage places such as timber yards. Occasionally houses have set themselves alight after being smashed by H. E. bombs, but taking it as a whole the actual effects have been—from the German point of view, and even from the enthusiastic bomb designer's point of view very disappointing. There have been some desperately narrow escapes, though. I know of one case where they missed an important aero engine factory by a matter of feet. In another they bombed without hitting, a wayside farm alongside a straight white road, evidently under the impression that it was a station on some important strategic railway. They never seem to hit the right thing. Which may be some consolation to any reader who is hit by a bomb for he or she may rest assured that the bomb was aimed at something else and not at him or her, as the case may be, so that there is no personal animosity about it, as it were. Having now dealt briefly with the bombs, we may proceed to the ships themselves.

Three Types of Airships.

In these days if one says "airship" everyone thinks "Zeppelin." As a matter of fact, a Zeppelin is only one type of airship among many, but as it is by far the most successful, it gets the credit for everything. There are, in effect, three types of airships—the non-rigid, the semi-rigid and the rigid.

The non-rigid are simply gas bags of gold-beaters skin or of special fabric, shaped to the approved cigar form, with a car slung below. The gas bag or envelope has to be kept in shape by internal pressure. To insure this, the gas bag has inside it another bag, known as a ballonet, which, when the main bag is full of gas, lies empty at the bottom of the envelope. As the gas escapes, or is let out, the ballonet is pumped up with air by a hand or engine-driven pump, and so the pressure of the gas above the ballonet is kept up and the envelope is kept distended.

This type of ship has not been a very great success in large sizes, though it must be said that the German "Parseval" type and the French "Astra-Torres" have done very good work for the British navy, as well as for the armies of their respective countries. In the smaller sizes, such as the little "submarine scouts," com-

monly known as "blimps," familiar to all who have travelled by sea along the British coast, the non-rigid type has been quite a success.

The semi-rigid type is a compromise, in which the non-rigid envelope has below it a rigid girder, to which the car is slung, so that if the envelope becomes flabby it does not directly interfere with the tilting of the car. Nevertheless, this type also, which includes the German Gross and the French "Lebaudy," it is necessary to use ballonets to keep up the pressure inside the envelope so as to make it retain its shape. For some curious reason—connected, I suppose, with the difficulty of making a long thin girder rigid enough to be reliable without being too heavy—the semi-rigid type has never been as successful as either the rigid or non-rigid types.

The rigid type differs from the others in having its framework outside the gas bags.

Thus, one may compare the three types to the invertebrates, vertebrates and crustaceans of the animal world. To the world in general there is only one rigid airship—the Zeppelin. As a matter of fact, the French "Spies" airship was invented and actually made in model form long before the Zeppelin, and it is even hinted in France that Count Zeppelin, on a visit to some aeronautical meeting in Paris, saw the Spies model and appropriated its basic ideas. Anyhow, M. Spies managed to get his ship only a few months before the outbreak of the war, and then it was not a huge success. What has happened to it since, I do not pretend to know. In any case, it has not been bombed by Zeppelins, so M. Spies has not "got his own back" yet.

Another rigid rival of the Zeppelin was the Schutte-Lanz, a ship which was in some ways superior to the Zeppelin, in that it was built of wood instead of aluminum, and so was handier at any rate; but more particularly in that it was cigar-shaped and not cylindrical, and so was a better "stream-line" shape. That is to say, it offered less resistance to the air, and so it could move faster through it with the same engine power.

Three or four Schutte-Lanz ships were built before the war and performed quite well. I gather, however, that under hard service conditions the wood skeleton "came unglued" and so the good points of the Schutte-Lanz were combined with those of the Zeppelin, and the Schutte-Lanz works were turned on to build the combined and revised Zeppelins, which are the more of the Schutte-Lanz type and of the Zeppelin internal construction. This story comes from a well-informed neutral source, and as the idea is so eminently sensible that it is just what the practical Germans would be likely to do, it is quite probably true. Moreover, one Schutte-Lanz was wrecked by a gale on the Danish coast early in 1915, and no one seems to have seen or heard of any others since then, so the story of the amalgamation has much to support it.

Zeppelin Construction.

Having fixed on the readers' minds the fact that there are other airships besides Zeppelins, I may now proceed to describe the actual structure of the Zeppelin itself.

Viewed externally, a Zeppelin consists of a long, narrow hull, shaped like a sixteen-sided tube, with egg-shaped ends, the nose end being blunt rather than the tail, rather as if one had bisected an egg and had struck the front and back of the tubular body. The sixteen sides of the tube are an important feature in the structure.

Along the bottom of the body there is a V-shaped keel, which in itself forms a communication passage for the crew from bow to stern of the ship besides acting as a stiffening girder against longitudinal strains to the ship. From the keel are slung two cars or "gondolas" as the Germans call them, from the fact that they are intended to float on the water like gondolas. Each car is placed about half way between the middle of the ship and its respective end. In the center of the ship the keel is bulged out to make a passenger cabin (in peace time) or a compartment for bombs and bomb-droppers in war.

The cars contain the engines, two in each car. Each engine works a shaft, like that of a motor car, which again, driven through heavy gearing, a propeller, which is carried on a kind of outrigger of steel tubing built on to the sides of the tubular hull. Thus one gets two propellers forward, one on each side of the hull, and two aft, likewise one on each side.

Some Have Extra Engine.

In addition, on some of the latest ships the aft car carries a third engine, which drives on to a fifth propeller fixed at the stern of the car itself, just like the propeller on a "pusher" aeroplane. Whether this is to be the standard fitting of the future is not known as yet, but it seems likely, as besides providing extra power, it probably would be an advantage in jockeying the ship upward with a sudden jump to escape from attacking aircraft or guns. This is done by depressing the tail and pointing the nose upward while driving full speed ahead. The sudden change in direction must necessarily put a big strain on the structure of the ship, but it is possible in this way to jump 1,000 feet or so in about thirty seconds, so it is worth doing as an emergency exit from a tight corner.

In the forward car are located the navigating controls and the pilots. Each car also contains its complement of engineers. Machine guns are carried in each car, and in the central saloon as well, so that probably six machine guns are carried below the hull.

It is stated, as a result of an examination of the wreckage of L. X. 77, brought down at Revin, in France, on February 21, that two other machines guns are carried on a turn-table on top of the hull. This system of

carrying guns to repel attacks from above was thought out for ships built in 1912 and 1913, but was abandoned for a time owing to the danger of the flame from the guns setting fire to the ship if there should be a gas leak anywhere near them, but apparently this danger is regarded in war time as being less than the danger from aeroplane bombs.

The Compartment Idea.

The idea in dividing a Zeppelin into compartments is precisely that of bulkheading a ship. Cross bracing of the hull is necessary to secure rigidity, and by making the cross bracing water-tight—in this case gas-tight—safety against sudden sinking is also secured. Also, in an airship, the ends of the ship are relieved of the excessive pressure when the ship rears up on its tail or dives suddenly, the pressure in a Zeppelin being taken by the transverse bracing, where in a single bag ship it would all be concentrated on one end of the bag.

The gas bags in a Zeppelin are so arranged that if two or three are punctured by a shell and lose all their gas the ship will still keep aloft as long as of course as the escaping gas does not catch fire. It is even said that by throwing overboard heavy articles, such as bombs, ammunition, guns, etc., the bare hull and the crew could be kept aloft by ten or twelve compartments out of the original eighteen.

I have heard it said by those who know something of airships that the modern Zeppelins are so designed that in extreme emergencies the whole of the engines can be jettisoned bodily, and we know from British official reports published early in April that a Zeppelin, which was hit either by a bomb from an aeroplane or by a shell from a gun, dropped "machinery" of some sort. One assumes it was a wireless apparatus or a spare engine parts. Also one knows that the big petrol tanks fitted for long distance raids, are built to be jettisoned quickly by releasing a couple of straps. All this is with the idea of giving the crew a sporting chance of drifting ashore if brought down at sea or of being helped into friendly territory by a favoring wind. Truly, the Germans have plenty of foresight and leave as little as possible to luck.

The original idea in making the cars as boats was that the early Zeppelins were experienced on Lake Constance from a floating shed which veered with the wind, so that the ships were floated in and out always "head-on," to whatever wind might be blowing. Judging from the fate of L-19 in the North Sea and L-30 off the Thames, it appears that the gondolas failed to function, but in those cases it appears that the hull was badly smashed and overweighted the flotation of the boats; but if there was still enough gas in the hull for it to keep itself aloft in the air, though not enough to lift the gondolas as well, it is probable that the gondolas would keep themselves and their load aloft on the water.

Very elaborate and cleverly designed machinery is fitted in Zeppelins to transfer gas from one gas bag to another, and so to keep the ship trimmed fore and aft. If one gas bag at one end is punctured and empties itself, naturally that end will sink, but it is possible, if the hole is not too big, for men to get inside that compartment and repair the hole, after which gas from the other compartments can be transferred to it and the necessary proportions of lift restored, even though the total life of the ship be reduced. The instruments used to indicate to the crew the exact amount and pressure of gas in each gas bag are very accurate and delicate, and are excellent examples of German ingenuity.

Zeppelin Dimensions.

From examination of the wreckage of L-27, which was brought down at Revin, it has been possible to obtain a fairly good idea of the dimensions of the newer Zeppelins. There is a revolutionary change from the pre-war type, but undoubtedly the newer ships are somewhat bigger.

The figures have been arrived at by examining the main and transverse girders, their curves and their calculated stress limits, compared with those of Z-VIII, brought down in France in August, 1914.

The growth of the Zeppelins may be stated thus:

1912 type—19,500 cubic meters, 141 meters long, 14.80 meters diameter.

1913 type—22,000 cubic meters, 156 meters long, 14.80 meters diameter.

1914 type—27,000 cubic meters, 158 meters long, 16.53 meters diameter.

1915 type—30,000 cubic meters, which indicates a length of about 160 meters, or about 540 feet, and a capacity of something over 1,000,000 cubic feet.

That, at any rate, disposes of the yarns from Swiss and Scandinavian sources about Zeppelins 400 yards long.

The shape of the wrecked ship was, as previously stated, more that of a cigar than of a cylinder. The five motors were all of the familiar Maybach type, with a bore of 150 millimeters (roughly six and one-half inches by seven inches), and giving 180 to 200 horse power each, so that the total horse power may be put down at 1,000.

Fuel Consumption.

The petrol consumption of these engines would be about 250 grammes per horse power per hour, or 506 rounds per hour for the whole power plant at full bore. The total oil consumption would be about thirty pounds per hour. Therefore a ten-hour flight at full speed would consume 5,650 pounds (about two tons, 8 cwt.) of fuel and oil.

No airship would, presumably, venture to cross to England with less than 100 hours' fuel on board, so that this load limits very considerably the bomb-carrying capacity.

A degree of accuracy greater than that of a big gun at anything like its extreme range. That is to say, a heavy gun, firing at a range of, say, ten to twelve miles, will not get so near its mark, even when assisted by a "spotting" aeroplane, as an aeroplane bomb, will, when dropped from 5,000 feet or so. And at 8,000 feet an aeroplane of ordinary size is moderately safe from being hit during the minute or two it takes in reaching that height from its original 12,000 feet, and in regaining that height, which is generally regarded as being quite safe from anti-aircraft guns and absolutely out of range of machine gun or rifle fire.

When the time comes for aeroplanes fitted with such bomb sights to raid German territory, either from

the sea or from ground near Germany itself, won back by the Allies, the German airship sheds will practically cease to exist.

It is, of course, possible that the ingenious German may then hide his airships in vast caverns dug in the sides of mountains, but even then he will be able to bring his airships out only at night instead of, as at present, making the greater part of the journey across the North Sea in daylight and crossing the British coast in the dark.

Such aeroplanes can be procured before very long if an energetic policy is pursued by the government; in fact the beginnings of them actually exist today, and need only tackling a problem in commercial production. When such fleets of aeroplanes are available German interference with British rest or work at night will cease and German ingenuity will have to stretch itself to its utmost and beyond if it is to produce an airship which can overcome all the dangers which will beset it.

On the other hand, the Germans have at their disposal continual weather information ranging from Ireland right around the Arctic Circle to the Russian frontier and over a thousand miles east from the Black Sea and the Adriatic. As a result they can always tell for at least ten or twelve hours ahead if any change is coming in from the northwest, northeast or southwest.

A wind of over 100 miles an hour would be a vast hurricane and it would take ten hours for such a wind to get from the limits of the German area of information to the North Sea, so that if a violent change is signalled, it is always possible for the meteorological bureau on shore to recall the airships by wireless before they are surprised by a storm.

That is why practically all the important Zeppelin raids have been made when the weather has been settling steadily from the east. A few single ships have risked a dash at the English coast in a west wind, but they have only been lone-hand ventures.

Speed and Altitude.

The top speed of a modern Zeppelin is supposed to be about seventy miles an hour, though some aeroplane pilots who have chased them unsuccessfully say it is more, and others who have caught them say it is less. In any case, the best Zeppelin is always slower than any really good aeroplane. Also it is well to remember that while the world's record for altitude is held by a German aeroplane, with 25,275 feet, the best on record for a Zeppelin is 10,000 feet. Any respectable aeroplane should be able to reach a height of 15,000 feet, and it is calculated that a Zeppelin could reach a height of only by jettisoning all its ballast, all its guns and about half its crew as well. So that if chased up to such a height by aeroplanes or by anti-aircraft guns a Zeppelin becomes innocuous. Not only so, but when it gets to such a height by such means, it will lose much gas by expansion in the rarified atmosphere, and when it wants to come down again the remaining gas will contract as it reaches the heavier air below. There will then be insufficient displacement of air to keep the ship aloft unless something else can be jettisoned to lighten the ship, the descent will become an uncontrollable fall.

A fully loaded Zeppelin approaching the British coast could hardly get above 7,000 or 8,000 feet. But after using a ton or so of fuel and dropping all its bombs it might perhaps rise to 12,000 feet or so. At that height it should still be an easy mark for clever anti-aircraft gunners, and a still easier one for a pilot on a first-class aeroplane fitted with a searchlight, which would enable him to keep the ship in view, when it was lost by the searchlight on the ground—for one assumes in these days that no airship will ever be so foolish as to cross an enemy's lines in daylight.

Taking it all around the Germans have every reason to be satisfied with the work their airships have done; but they have to thank British conservatism as much as their own ingenuity for that success. If the government of the past had realized the importance of adequate aerial defense Great Britain would have had its own super-Zeppelins to meet German airships in fair fight and it would have had aeroplanes properly equipped as "destroyers" to attack airships at night.

Defense and Counter-Attack.

Mr. Churchill promised "swarm of hornets" was no empty boast. He used the phrase to indicate what would happen if airships came to England in daylight—doubtless remembering that all the best hornets go to bed at dusk. Nevertheless, if his policy had been properly backed up by his technical advisers there would have been a flock of night-hawks ready for Zeppelins at night.

That no such machines exist is one of the matters still to be put right by those of us who are agitating for aerial reform. The right machines and the right men can be got in the British empire, and they will be got before present agitation ceases. Meantime, no doubt other airship raids will be made from Germany, and they will strengthen very materially the support accorded by the British public to the reform party.

When those reforms are carried through and when the supply and construction of British aircraft are put in the hands of practical men who know their business German airships are likely to find short shift on the west of the North Sea.

Also, as certain new machines and new engines are developed, it is unlikely that German attack will be as easy as it now is. An airship shed is an easy mark for a bomb-dropper, and bomb-sighting apparatus for aeroplanes has now been produced which gives a degree of accuracy greater than that of a big gun at anything like its extreme range. That is to say, a heavy gun, firing at a range of, say, ten to twelve miles, will not get so near its mark, even when assisted by a "spotting" aeroplane, as an aeroplane bomb, will, when dropped from 5,000 feet or so. And at 8,000 feet an aeroplane of ordinary size is moderately safe from being hit during the minute or two it takes in reaching that height from its original 12,000 feet, and in regaining that height, which is generally regarded as being quite safe from anti-aircraft guns and absolutely out of range of machine gun or rifle fire.

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It is, of course, possible that the ingenious German may then hide his airships in vast caverns dug in the sides of mountains, but even then he will be able to bring his airships out only at night instead of, as at present, making the greater part of the journey across the North Sea in daylight and crossing the British coast in the dark.

Such aeroplanes can be procured before very long if an energetic policy is pursued by the government; in fact the beginnings of them actually exist today, and need only tackling a problem in commercial production. When such fleets of aeroplanes are available German interference with British rest or work at night will cease and German ingenuity will have to stretch itself to its utmost and beyond if it is to produce an airship which can overcome all the dangers which will beset it.

On the other hand, the Germans have at their disposal continual weather information ranging from Ireland right around the Arctic Circle to the Russian frontier and over a thousand miles east from the Black Sea and the Adriatic. As a result they can always tell for at least ten or twelve hours ahead if any change is coming in from the northwest, northeast or southwest.

A wind of over 100 miles an hour would be a vast hurricane and it would take ten hours for such a wind to get from the limits of the German area of information to the North Sea, so that if a violent change is signalled, it is always possible for the meteorological bureau on shore to recall the airships by wireless before they are surprised by a storm.

That is why practically all the important Zeppelin raids have been made when the weather has been settling steadily from the east. A few single ships have risked a dash at the English coast in a west wind, but they have only been lone-hand ventures.

Speed and Altitude.

The top speed of a modern Zeppelin is supposed to be about seventy miles an hour, though some aeroplane pilots who have chased them unsuccessfully say it is more, and others who have caught them say it is less. In any case, the best Zeppelin is always slower than any really good aeroplane. Also it is well to remember that while the world's record for altitude is held by a German aeroplane, with 25,275 feet, the best on record for a Zeppelin is 10,000 feet. Any respectable aeroplane should be able to reach a height of 15,000 feet, and it is calculated that a Zeppelin could reach a height of only by jettisoning all its ballast, all its guns and about half its crew as well. So that if chased up to such a height by aeroplanes or by anti-aircraft guns a Zeppelin becomes innocuous. Not only so, but when it gets to such a height by such means, it will lose much gas by expansion in the rarified atmosphere, and when it wants to come down again the remaining gas will contract as it reaches the heavier air below. There will then be insufficient displacement of air to keep the ship aloft unless something else can be jettisoned to lighten the ship, the descent will become an uncontrollable fall.

A fully loaded Zeppelin approaching the British coast could hardly get above 7,000 or 8,000 feet. But after using a ton or so of fuel and dropping all its bombs it might perhaps rise to 12,000 feet or so. At that height it should still be an easy mark for clever anti-aircraft gunners, and a still easier one for a pilot on a first-class aeroplane fitted with a searchlight, which would enable him to keep the ship in view, when it was lost by the searchlight on the ground—for one assumes in these days that no airship will ever be so foolish as to cross an enemy's lines in daylight.

Taking it all around the Germans have every reason to be satisfied with the work their airships have done; but they have to thank British conservatism as much as their own ingenuity for that success. If the government of the past had realized the importance of adequate aerial defense Great Britain would have had its own super-Zeppelins to meet German airships in fair fight and it would have had aeroplanes properly equipped as "destroyers" to attack airships at night.

Mr. Churchill promised "swarm of hornets" was no empty boast. He used the phrase to indicate what would happen if airships came to England in daylight—doubtless remembering that all the best hornets go to bed at dusk. Nevertheless, if his policy had been properly backed up by his technical advisers there would have been a flock of night-hawks ready for Zeppelins at night.

That no such machines exist is one of the matters still to be put right by those of us who are agitating for aerial reform. The right machines and the right men can be got in the British empire, and they will be got before present agitation ceases. Meantime, no doubt other airship raids will be made from Germany, and they will strengthen very materially the support accorded by the British public to the reform party.

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